What is claimed is:

1   1. A control program development support apparatus
2   comprising:

3   a control program execution unit for executing
4   a control program, which controls an operation of a
5   mechanism, to calculate and output a controlled
6   variable for said mechanism in a predetermined cycle;

7   a simulation unit, in which said mechanism is
8   configured as a virtual model, for simulating, in a
9   predetermined cycle which is set shorter than said
10 predetermined control cycle, an operation of said
11 mechanism for a time corresponding to said
12 predetermined control cycle, by using said model, to
13 calculate and output a state variable of said
14 mechanism;

15   a holding unit, arranged between said control
16 program execution unit and said simulation unit, for
17 temporarily holding said controlled variable from said
18 control program execution unit to transfer said
19 controlled variable to said simulation unit, whereas
20 temporarily holding said state variable from said
21 simulation unit to transfer said state variable to said
22 control program executing unit; and

23   a simulation control unit for making said
24 simulation unit shift to a state of waiting for a
25 response from said control program execution unit and

26   making said control program execution unit initiate

27   an operation of calculating a controlled variable

28   according to said state variable when said state

29   variable from said simulation unit is held in said

30   holding unit, whereas making said control program

31   execution unit shift to a state of waiting for a response

32   from said simulation unit and making said simulation

33   unit initiate a simulating operation according to said

34   controlled variable when said controlled variable from

35   said control program execution unit is held in said

36   holding unit.

1   2. A control program development support apparatus

2   comprising:

3   a control program execution unit for executing

4   a control program, which controls an operation of a

5   servo mechanism, to calculate and output a controlled

6   variable for said servo mechanism in a predetermined

7   control cycle;

8   a simulation unit, in which said servo

9   mechanism is configured as a virtual model, for

10   simulating, in a predetermined simulation cycle which

11   is set shorter than said predetermined control cycle,

12   an operation of said servo mechanism for a time

13   corresponding to said predetermined control cycle,

14   while dynamically analyzing the operation of said servo

15   mechanism by using said model, to calculate and output

16   a state variable of said servo mechanism;

17   a holding unit, arranged between said control

18   program execution unit and said simulation unit, for

19   temporarily holding said controlled variable from said

20   control program execution unit to transfer said

21   controlled variable to said simulation unit, whereas

22   temporarily holding said state variable from said

23   simulation unit to transfer said state variable to said

24   control program executing unit; and

25   a simulation control unit for making said

26   simulation unit shift to a state of waiting for a

27   response from said control program execution unit and

28   making said control program execution unit initiate

29   an operation of calculating a controlled variable

30   according to said state variable when said state

31   variable from said simulation unit is held in said

32   holding unit, whereas making said control program

33   execution unit shift to a state of waiting for a response

34   from said simulation unit and making said simulation

35   unit initiate a simulating operation according to said

36   controlled variable when said controlled variable from

37   said control program execution unit is held in said

38   holding unit.

1   3. The control program development support apparatus

2   according to claim 2 further comprising a synchronous

3   setting means for performing synchronous setting of

4 said simulation control unit.

1 4. The control program development support apparatus

2 according to claim 3, wherein said synchronous setting

3 means is configured using a graphical user interface

4 function.

1 5. The control program development support apparatus

2 according to claim 2, wherein said control program

3 execution unit outputs a plurality of controlled

4 variables to be inputted to said simulation unit at

5 different timings during one control cycle; and

6   said control program development support

7 apparatus further comprises a multi-rate control means

8 for performing an input control on said plural

9 controlled variables such that said controlled

10 variables are inputted to said simulation unit at

11 respective predetermined timings.

1 6. The control program development support apparatus

2 according to claim 5 further comprising a multi-rate

3 setting means for performing setting of said multi-rate

4 control means.

1 7. The control program development support apparatus

2 according to claim 6, wherein said multi-rate setting

3 means is configured using a graphical user interface

4   function.

1   8. The control program development support apparatus

2   according to claim 2, wherein said simulation control

3   unit determines a timing, at which said control program

4   execution unit starts calculating said controlled

5   variable, on the basis of a result of simulation by

6   said simulation unit.

1   9. The control program development support apparatus

2   according to claim 2, wherein said model is configured

3   with a plurality of parts of which operations can be

4   separately simulated; and

5   said simulation unit comprises a plurality of

6   processors for simulating in parallel the operations

7   of said plural parts.

1   10.   The control program development support apparatus

2   according to claim 2, wherein said holding unit

3   comprises:

4   a plurality of registers for temporarily

5   holding data including said controlled variable to be

6   transferred from said control program execution unit

7   to said simulation unit and said state variable to be

8   transferred from said simulation unit to said control

9   program execution unit;

10   a first write/read control unit for

11 controlling writing/reading of said data between said

12 plural registers and said control program execution

13 unit; and

14 a second write/read control unit for

15 controlling writing/reading of said data between said

16 plural registers and said simulation unit.

1 11. The control program development support apparatus

2 according to claim 10, wherein an interrupt signal,

3 which is inputted to one of said plural registers from

4 said simulation unit in order to make said control

5 program execution unit initiate the operation of

6 calculating said controlled variable, is directly sent

7 from said register to said control program execution

8 unit without reference to said first write/read control

9 unit.

1 12. The control program development support apparatus

2 according to claim 10 further comprising a data display

3 unit for displaying data held in said plural registers.

1 13. The control program development support apparatus

2 according to claim 12 further comprises a selecting

3 unit for selecting at least one register from said

4 plural registers to make said data display unit display

5 data held in said selected register.

1 14. The control program development support apparatus
2 according to claim 12, wherein said data display unit
3 is directly connected to a specific register among said
4 plural registers to display data held in said specific
5 register.

1 15. The control program development support apparatus
2 according to claim 10 further comprises a data input
3 unit for forcedly setting and storing desired data in
4 at least one of said plural registers.

1 16. The control program development support apparatus
2 according to claim 15, wherein said data input unit
3 is directly connected to a specific register among said
4 plural registers to set said desired data in said
5 specific register.

1 17. The control program development support apparatus
2 according to claim 1 further comprises a noise
3 superposing unit for superposing noise on data read
4 out from at least one of said plural registers.